NERC
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Panel I: State of Reliability and Emerging Issues

Remarks of Thomas Burgess
Vice President and Director of Reliability Assessment and Performance Analysis
North American Electric Reliability Corporation
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Introduction

Acting Chairman La Fleur and Commissioners, members of the respective Commissions, staff and guests. My name is Tom Burgess and I am the Vice President and Director, Reliability Assessments and Performance Analysis at the North American Electric Reliability Corporation (NERC). Section 215 of the Federal Power Act, enacted by the Energy Policy Act of 2005, provides among other functions that NERC conduct periodic assessments of the reliability and adequacy of the bulk power system (BPS) in North America. NERC independently assesses and reports on both the actual performance of the BPS as well as the reliability and adequacy across the planning horizon. It is my privilege to update you today on the results and key findings of the State of Reliability report, which is among the premier evaluations of BPS performance.

Overview of the State Of Reliability

NERC's State *of Reliability 2014* report represents NERC's independent view of ongoing BPS trends to objectively analyze its state of reliability and provide an integrated view of reliability performance. The key findings and recommendations serve as technical input to NERC's risk assessment, reliability standards project prioritization, compliance process improvement, event analysis, reliability assessment, and critical infrastructure protection.

This analysis of BPS performance developed as part of this report provides an industry reference of historical reliability, offers analytical insights toward industry action, and enables the identification and prioritization of specific steps that can be taken to manage risks to reliability. This year's report presents the coordinated activities across NERC departments to address risks to reliability that have been identified in prior State of Reliability reports. The following is an overview of the key findings and recommendation to address any identified risks.

Key Findings

Sustained Bulk Power System Reliability Performance

The first key finding in the report is that there is sustained high performance for BPS reliability. NERC has calculated a severity risk index value for each day for the years 2008 through 2013. The severity risk index is a daily, blended metric where transmission loss, generation loss, and load loss events are aggregated into a single value that represents the performance of the system. These daily performance measurements are used to evaluate the year-on-year performance of the system.

Including weather-initiated events, 2013 had no high-stress days. In other words, there were no days with a severity risk index greater than 5.0. On average, the severity risk index was approximately as good as the performance achieved since 2008, which matches the best performance over that period. From 2008 through 2013, the majority of high-stress days (days with high severity risk index scores) were weather-initiated or weather-exacerbated; only a small number of days were associated with initiating events internal to the BPS.

The availability of the bulk transmission system continues to remain high from 2008 to 2013. AC transmission circuit availability remains above 97 percent, and transmission transformer availability is above 98 percent for the 2010 to 2013 period (unavailability includes both forced and planned outages). High transmission availability demonstrates that the BPS is able to operate reliably over a variety of operating conditions.

Frequency Response Remains Stable

The next key finding is that the frequency response of the BPS remains stable. From 2009 to 2013, the Eastern Interconnection, ERCOT Interconnection, Québec Interconnection, and Western Interconnection have shown steady frequency response performance, trending above the recommended interconnection frequency response obligation at all times during the study period. The Eastern Interconnection data showed a slightly downward trend in frequency response, however the trend is not statistically significant. It is important to continue to monitor these trends to determine whether any of these trends approach or drop below the interconnection frequency response obligation for any interconnection. There were no reported Event Analysis Process qualified events in 2013 where frequency response performance was cited as a causal factor for initiating or sustaining an event. There were a few instances in 2013 where frequency response was less that the interconnection frequency response obligation in ERCOT and the East, and those instances should be studied for system information.

FERC approved BAL-003-1 Reliability Standard on January 16, 2014. This standard establishes a minimum frequency response obligation for each Balancing Authority, provides a uniform calculation of frequency response and frequency bias settings that transition to values closer to natural frequency response, and encourages coordinated Automatic Generation Control operation. This standard, in partnership with BAL-001-2, maintains interconnection steady-state frequency within defined limits by balancing real power demand and supply in real-time. BAL-003-1 will ensure that Balancing Authorities take actions to maintain interconnection frequency, with each Balancing Authority contributing its fair share to frequency control. BAL-001-2 is pending regulatory approval.

The report provides two recommendations on this key finding. NERC will examine and develop root causes for incidents in 2013 where frequency response was less than the Interconnection Frequency Response Obligation. NERC will determine additional actions, beyond those currently being worked on in NERC Standards, which should be taken to maintain and improve frequency response performance.

Protection System Misoperations Cause Transmission Events

The third key finding is that protection system misoperations cause transmission events. Protection System Misoperation was identified in previous years as an event that has a significant probability of occurrence and is positively correlated with transmission severity when outages do occur. Below are additional findings from analyses of misoperations from 2011 through 2013:

- Misoperation occurrences have been consistent over the past three years, with approximately 2,000 misoperations per year.
- The rate of misoperations, as a percentage of total operations, has remained consistent during period at approximately 10 percent (i.e., roughly one in 10 operations is a misoperation).
- The three most common causes of misoperations remain the same (approximately 65 percent of misoperations are caused by settings/logic/design errors, communication failures, and relay failures).

Three datasets are available to better understand the impact of misoperations on reliability. One dataset is a database of all misoperations that occur on the BES (100 kV and above) that is collected on a quarterly basis by NERC and its Regional Entities. This database provides a comprehensive set of data for all transmission and generation misoperations. It is submitted by the system protection owners and includes detailed information about the misoperation, including a description of the misoperation, its category, its causes, and the proposed mitigation and completion date.

A second dataset that is used to assess risk associated with misoperations is the event reports that are submitted to NERC and its Regional Entities through the event analysis program. When misoperations are associated with reported system disturbances, NERC can then assess their actual impact on the BES and also identify whether they were causal or contributory to the event through cause coding.

A third source of misoperations reporting occurs through the TADS data collection. Misoperations that were identified as being caused by human error or relay failure are identified in TADS reporting. This occurs for transmission facilities operated at 200 kV and above. Focusing the statistical analysis of the 2012–2013 TADS data on the transmission severity and initiating causes of TADS events yields the following results and observations:

- Excluding Weather-related and Unknown Initiating Cause Codes (ICC), misoperations is one of the two largest contributors to the transmission severity risk.
- TADS events initiated by misoperations and Failed AC substation equipment ICCs have a greater expected severity than all other TADS ICC events.

Based upon the total number of misoperations experienced by the industry, the relationship between the misoperations ICC and transmission risk, and the positive correlation between misoperations and transmission severity, understanding and reducing misoperations should remain a focus of NERC and industry participants.

NERC is continuing activity on several projects to address protection system misoperations. The Reliability Issues Steering Committee has identified system protection reliability, uncoordinated protection systems, and protection system misoperations as top priority risks to reliability. NERC has focused its Reliability Standards efforts in this area with the completion of the relay loadability standards and continues work on relay misoperations and coordination. In addition, NERC staff is coordinating with the North American Transmission Forum to find ways to reduce protection system misoperations and develop ways to minimize the impact of misoperations. Events Analysis is continuing to examine system events to identify those that are impacted by protection system misoperations to determine if action is needed to address trends and common modes of misoperations.

For misoperations, the report provides two recommendations on this key finding. NERC will complete development of PRC-004-3 Reliability Standard - Protection System Misoperation Identification and Correction. And NERC will develop a plan and initiate industry action to address the three most common causes of protection system misoperations (settings/logic/design errors, communication failures and relay failures).

The analysis of transmission outage data showed that misoperations and failed AC substation equipment had the largest positive correlation with transmission outage severity. In other words, transmission events initiated by these two causes tended to have higher transmission severity, or greater transmission system impact, than other transmission events that occurred in 2012 and 2013.

Substation Equipment Failures Impact Transmission Event Severity

Key finding number four is that Substation Equipment Failures Impact Transmission Event Severity. AC substation equipment failures had the largest positive correlation with automatic transmission outage severity in 2013. A similar observation was made in 2013 in key finding number five of the *2013 State of Reliability* report. NERC recommended that a small subject matter expert technical group be formed to further validate the findings and root causes to understand the contributing factors to AC substation equipment failures and provide solutions to improve performance. The AC Substation Equipment Task Force was created to address high priority reliability issues related to AC substation equipment. The task force has gathered AC substation equipment failure data from multiple sources, including the Events Analysis program, TADS, and a supplemental TADS survey conducted by the task force. The failure data is currently being analyzed by the task force. The final report is scheduled to be completed by December 31, 2014 and results will be incorporated in *2015 State of Reliability* report.

In addition, NERC is focusing on increasing awareness of this risk to reliability. For example, NERC developed the adequate level of reliability metric, ALR6-13 AC Transmission Outages Initiated by Failed AC Substation Equipment, to measure performance changes in failed ac substation equipment. The metric shows that outages per element demonstrate year-over-year improvement from 2011 to 2013. Information concerning this metric is posted on NERC's website.

NERC's analysis of substation equipment, specifically circuit breakers, identified a failure trend for a specific type of circuit breaker in many of the reported events. A case history was established for a specific type of 345 kV SF_6 puffer-type circuit breaker failure. The average time between reported failures of these breakers was 4.2 months for the six failures discovered in the NERC Event Analysis program. NERC further uncovered a maintenance advisory published for this equipment that indicated the need for equipment modification. These analyses resulted in NERC issuing a Level 1 advisory alert regarding identification of a trend in 345 kV SF_6 puffer-type circuit breaker failures and the potential risk it posed to reliability. The purpose of the alert was to ensure industry was aware of the recent failures and previously published maintenance advisories, so appropriate action could be taken by entities that have this particular equipment. Since the alert was published, there have been no reported events caused by this failure mechanism.

The report provides three recommendations on the subject of AC substation equipment failures. NERC will assess the implementation and effectiveness of the Level 1 advisory issued to address 345 kV SF6 puffer type breakers failures. NERC will develop a plan with milestones to address the causes of substation equipment failures identified

by the AC Substation Equipment Task Force. NERC will develop and facilitate data collection necessary to perform future analysis of substation equipment failures, as recommended by the task force.

Declining Use of Energy Emergency Alert Level 3

The final key finding is that the use of Energy Emergency Alert Level 3 is declining. In 2013 there were seven Energy Emergency Alert Level 3 events declared, which is significantly less than the number that occurred in prior years. Energy Emergency Alert trends provide a relative indication of performance measured at a Balancing Authority or interconnection level. By definition, when an Energy Emergency Alert Level 3 alert is issued, firm-load interruptions are imminent or in progress. An Energy Emergency Alert Level 3 indicates an issue with the real-time adequacy of the electric supply system. It may be due to a lack of fuel or dependence on transmission for imports into a constrained area, not simply a lack of available generation resources. In 2013, NERC began to collect and analyze more information surrounding Energy Emergency Alert Level 3 events, including load shed if any. Only one of the seven Energy Emergency Alert 3 events in 2013 required firm load to be shed to preserve reliability of the BPS. This further demonstrates the ability of the BPS to perform well under stressed conditions.

There were eight instances of load shedding to mitigate actual and post-contingency transmission system conditions in 2013. The total amount of load shed did not exceed 300 MW in any of these events, and all but one were less than four hours in duration. In all eight instances, the use of load shedding was successful at preventing greater and more widespread impacts. The report provides the following recommendation on this key finding: NERC will analyze system events that resulted in firm load shedding to determine any common causes or trends that warrant action.

State of Reliability Summary

The goal of the State of Reliability report is to quantify risk and performance, highlight areas for improvement, and reinforce and measure success in controlling these risks. A number of activities are in place to further these objectives.

The Reliability Issues Steering Committee continues to identify top priority risks to reliability. The ongoing work in the Performance Analysis area of NERC provides a foundation for their risk assessments. These top priority risks are being packaged into specific project work aimed at addressing components of reliability risk.

For example, in 2014, the following projects are now ongoing:

- Changing Resource Mix
- Extreme Physical Events
- Protection System Misoperations
- Cold Weather Preparedness
- Right-of-Way Clearances
- 345 kV Breaker Failures

NERC continues to develop solutions to evolving threats to reliability. The BPS is a highly interconnected system with some remaining challenges including weather (e.g. droughts, floods, severe winter), and the potential for major cyber and physical attacks. The Bulk Electric System Security Metrics Working Group, under the direction of the Critical Infrastructure Protection Committee, is developing security performance metrics.

NERC continues to examine impacts on the BPS related to the changing resource mix. Reliably integrating high levels of variable resources (wind, solar, and some forms of hydro) into the BPS will require significant changes to traditional methods used for system planning and operation. The amount of variable renewable generation is expected to grow considerably as policy and regulations on greenhouse gas emissions are being developed and implemented by federal authorities and individual states and provinces throughout North America. Power system planners must consider the impacts of variable generation in power system planning and design and develop the necessary practices and methods to maintain long-term BPS reliability. Operators will require new tools and practices, including potential enhancements to NERC reliability standards or guidelines to maintain BPS reliability. NERC is defining essential reliability services and possible sources for those services. NERC expects to form a task force to continue the work on this subject.

The ability to extract key insights, trends, and performance behavior depends in large part on sophisticated analysis of extensive databases of reliability information. A key part of that is integrating Event Analysis data with these performance analysis databases to affirm insights and identify proactive steps to avoid reliability problems. Accordingly, NERC is accentuating its focus on the statistical analysis and cross-correlations among the various databases (Transmission Availability Data System, Distribution Availability Data System, Generation Availability Data System) as well as with insights and observations from the Events Analysis program.

Conclusion

The overall continued focus on advance identification of potential threats to reliability and proactive key actions will help ensure that the BPS maintains its high sustained performance and supports the ERO in fulfilling its mission. This concludes my presentation and discussion of the recently approved *State of Reliability 201*4 report, thank you for your attention to this information.